

--	--	--	--	--	--	--	--	--	--

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

EEL3036 – POWER SYSTEMS ANALYSIS (LE)

14 OCTOBER 2017
2.30 p.m – 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages including the cover page with 4 Questions only.
2. Answer **ALL** questions. The distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

- (a) List out THREE advantages of per unit power system. [6 Marks]
- (b) Figure Q1 shows a simple power system consisting of one synchronous generator and one synchronous motor connected by two transformers and a transmission line. Using a base apparent power of 100 MVA and base line voltage at generator G of 13.8 kV. Obtain the following:
- Calculate the impedance values for these power system components expressing all the values in per unit. [15 Marks]
 - Draw an impedance diagram with all the values properly placed in the drawing. [4 Marks]

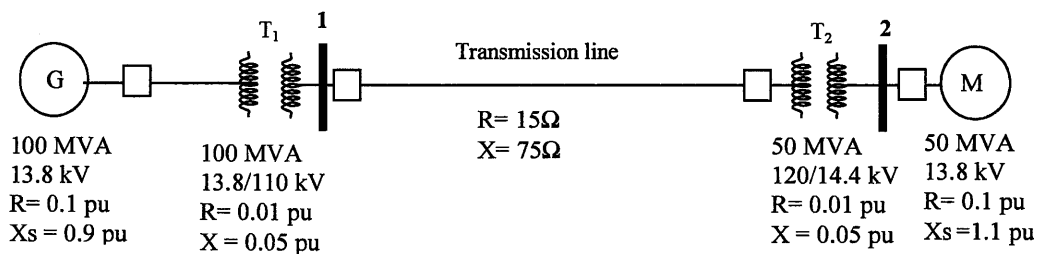


Figure Q1

Question 2

In the power system network shown in Figure Q2, bus 1 is the slack bus, bus 2 is the voltage-controlled bus and bus 3 is the load bus. All the values shown in the figure are in per unit.

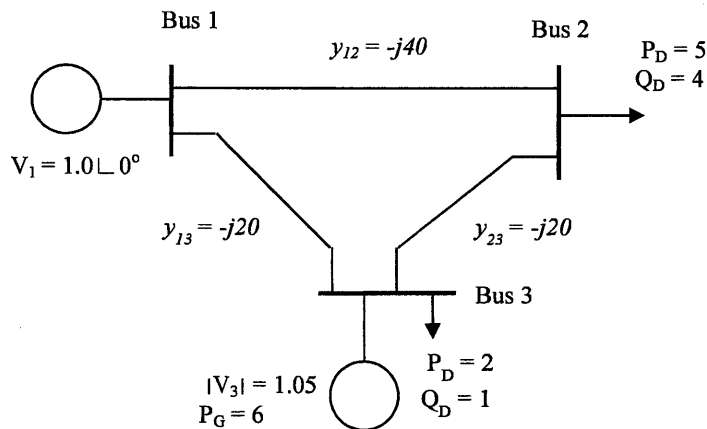


Figure Q2

- (a) Compute the Y_{bus} for load flow analysis [5 Marks]

Continued...

- (b) Using Gauss-Seidel method, determine V_2 at the end of first iteration. [8 Marks]
- (c) In order to carry out power flow study of the system using the Newton-Raphson method, assuming all the angle corrections $\Delta\delta_2$ and $\Delta\delta_3$ are zero degree, calculate the Jacobian elements in the:
- (i) second row and third column, and [5 Marks]
- (ii) third row and second column. [7 Marks]

Question 3

A 3-phase fault is developed at point F of the system shown in the given single-line diagram. Assume that all loads do not contribute to system fault level.

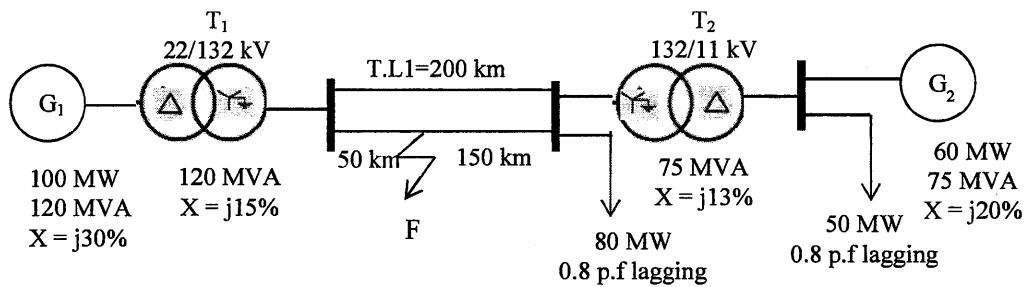


Figure Q3

- (a) The lines have reactance of $0.5 \Omega/\text{phase}/\text{km}$. Calculate the actual reactance values for upper transmission line (X_{L1}) and lower transmission lines (X_{L21} and X_{L22}). [3 Marks]
- (b) Choose an MVA_{base} of 120 MVA, a voltage base for each voltage level of the system is $V_{G1}=22 \text{ kV}$, $V_{\text{lines}}=132 \text{ kV}$ and $V_{G2} = 11 \text{ kV}$, calculate the new reactance values in per unit values for Generator 1 (G_1), Transformer 1 (T_1), Generator 2 (G_2), Transformer 2 (T_2), Transmission line 1 (TL_1), Transmission line 2 (TL_{21}), and Transmission line due to fault (TL_{22}). [7 Marks]
- (c) Determine the short-circuit current in per unit and its actual value in Ohm. [Hint: Draw a reactance diagram, and simplify it until you get the final reactance value] [15 Marks]

Continued...

Question 4

- (a) The system shown in Figure Q4a delivers 1.0 p.u. and both the terminal voltage of the generator and the infinite bus is 1.0 p.u. The per unit reactances are marked in the figure. Calculate the power angle equation, and sketch the power angle curve for this problem. [13 Marks]

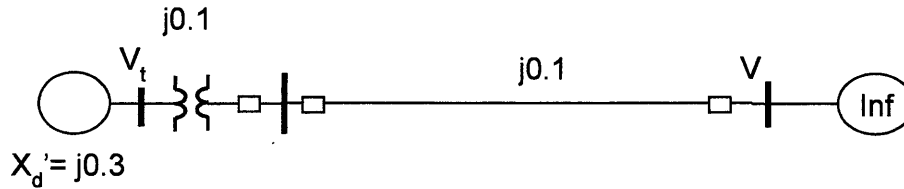


Figure Q4a

- (b) A power system network is shown in Figure Q4b. It consists of 3 generators and 4 loads. Y_{bus} for a 4-bus reactive network is given by

$$\begin{bmatrix} -j30 & j15 & j5 & j10 \\ j15 & -j25 & 0 & j10 \\ j5 & 0 & -j10 & j5 \\ j10 & j10 & j5 & -j25 \end{bmatrix}$$

The reactances of the generators in per unit are: $X_{d1}' = 0.15$; $X_{d2}' = 0.25$; $X_{d3}' = 0.1$. The complex loads at the buses in per unit are: $P_2 + jQ_2 = 1.2 + j0.5$; $P_3 + jQ_3 = 1.0 + j0.4$; $P_4 + jQ_4 = 1.5 + j0.0$. The magnitude of bus voltages have been computed in per unit as $V_1 = 1.05$, $V_2 = 1.02$, $V_3 = 1.03$, $V_4 = 0.95$. A three-phase fault occurs at bus 3 and is cleared after 0.2 s. Compute the following.

- (i) Prefault augmented bus admittance matrix. [10 Marks]
 (ii) During-fault augmented bus admittance matrix. [2 Marks]

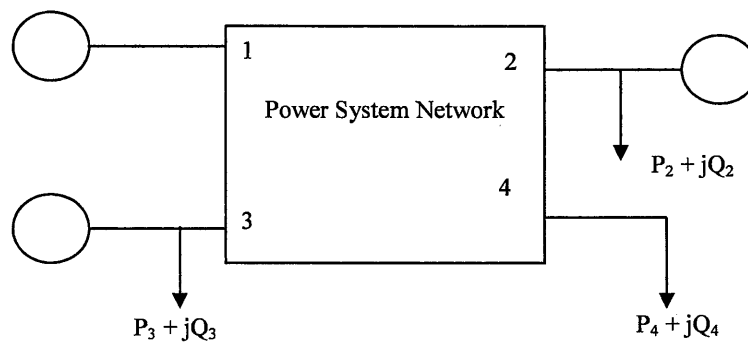


Figure Q4b

End of Paper.

